Coastal Benthic Optical Properties of Coral Environments

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LONG-TERM GOALS

The deconvolution of the various components of water-leaving radiance in shallow coastal waters with emphasis on coral environments is the long term goal of the project. Work toward this goal has been continued under Award Number N00014-97-1-0006 (see accompanying report for progress to date).

OBJECTIVES

In this project, objectives include the development of instrumentation and models to measure and predict the contribution of bottom reflectance to upwelling radiance in coastal waters. An underlying objective, then, is the development of the methodologies required to remotely classify bottom types in varying water depths.

APPROACH

Transects over coral reef bottoms were laid out and mapped by divers and by the Fluorescence Imaging Laser Line Scanner (FILLS). Instrumentation aboard the ROV and AUV platforms were used to determine the color and intensity of bottom elements from different altitudes with the goal of correcting imagery for path radiance and attenuation, providing bottom albedo estimates for the dominant bottom types/features, imaging bottom fluorescence, and measuring the vertical spectral structure of the upwelling and downwelling light fields.

WORK COMPLETED

As a follow-up to a multi-team, three-ship expedition off Long Key during August, 1995, we helped organize, and participated in, a multi-team, two-ship expedition off Loggerhead Key in July, 1996. Both sites are coral reef environments within Fort Jefferson National Monument, Dry Tortugas, during August, 1995. Additionally in both years we sampled at a clear, deep water (100 fathoms) station and also visited two NOAA sites south of the Tortugas in 1996. During all experiments, we monitored solar flux, remote sensing reflectance and atmospheric transmissivity, filtered water samples for particulate spectral absorption coefficients, and deployed our optical instrumentation, the Bottom Classification/Albedo package (BCAP), both aboard the OV-II autonomous underwater vehicle (AUV) and the ROSEBUD

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remotely operated vehicle (ROV). The BCAP/ROSEBUD configuration provided 800 watts of metal-hallide arc lighting on demand which was configured to produce both broadband white illumination and narrowband, UV-A illumination for stimulated fluorescence imaging and classification. BCAP was deployed in conjunction with Applied Remote Technology's Fluorescence Imaging Laser Line Scanner (FILLS) system aboard HBOI's Clelia manned submersible and flyovers of NRL-Washington aircraft carrying hyperspectral imaging sensors (eg. CASI, PHILLS). Data reduction is underway.

RESULTS

- Quantified the effects of reflectance from various bottom types have on (provide to) diffuse attenuation coefficients for not only upwelling radiance but also near-bottom downwelling irradiance in moderately turbid water.
- Upwelling radiance included fluorescence contributions at 490-520 nm (over coral) and 685 nm (over coral and sand).
- Path radiance at 685 nm was negligible so that bottom imagery at that wavelength was of much higher contrast than conventional imagery (elastic scatter) collected at shorter wavelengths.
- Initial tests of a prototype micro-topography measurement system were successful; an system high-speed, automated system is under development.

IMPACT/APPLICATIONS

Data acquired will assist CoBOP investigators in describing the underwater light field and developing/parameterizing models of benthic environments. Bottom classification through analysis of elastic and inelastic imagery will lead to automation of bottom mapping and characterization.

TRANSITIONS

Acquisition of fluorescence imagery is expected to become a useful tool for classfying natural and altered benthic environments. The micro-topography system will enhance interpretation of data acquired through FILLS and other systems dependent upon small-scale, precise, range information.

RELATED PROJECTS

As part of the CoBOP program, this project is synergistic with numerous other CoBOP investigations. This project also provides data to and benefits from instrumentation developed under "Optical Variability and Bottom Classification in Turbid Water" (ONR CODE 3220M).

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